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MRCSP
MIDWEST REGIONAL
CARBON SEQUESTRATION
PARTNERSHIP

Application of a Comprehensive Environmental Permitting Approach for the Michigan Basin Test Site,
Midwest Regional Carbon Sequestration Partnership

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3. DTE Energy, Detroit, Michigan, USA

Sixth Annual Conference on Carbon Capture & Sequestration

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Acknowledgements- Project Team

Abed Houssari and Becky Cook

Dave Barnes and Bill Harrison

Dave Ball, Danielle Meggyesy, Judith Bradbury, Bob Janosy, Jackie Gerst, Matt Place

Charlie Byrer

Robert Mannes and Joe Herpst

Additional Contributions by Numerous Other MRCSP Team Members

Presentation Objectives

- Project Summary/Site Description
- Initial Site Screening
- Preliminary Geological Assessment
- Well installation/completion
- EPA Underground Injection Control Permit
- Injection, MMV Plans
- Conclusions

Project Summary

- MRCSP is one of seven U.S. DOE/NETL Regional C Seq. Partnerships.
- Eight-state region of IN, KY, MD, MI, NY, OH, PA, and WV.
- Phase I Launched, fall 2003; Phase II commenced October 2005.
- Michigan Basin site is one of three geologic test sites.

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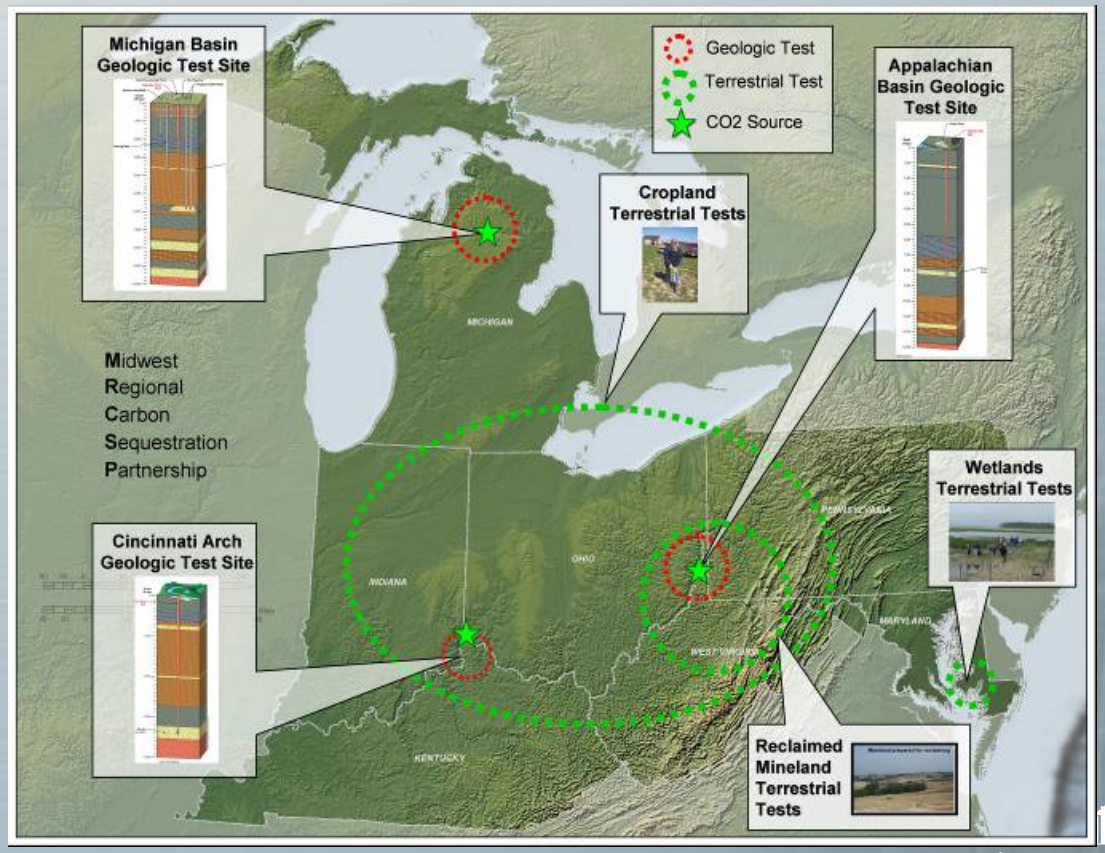
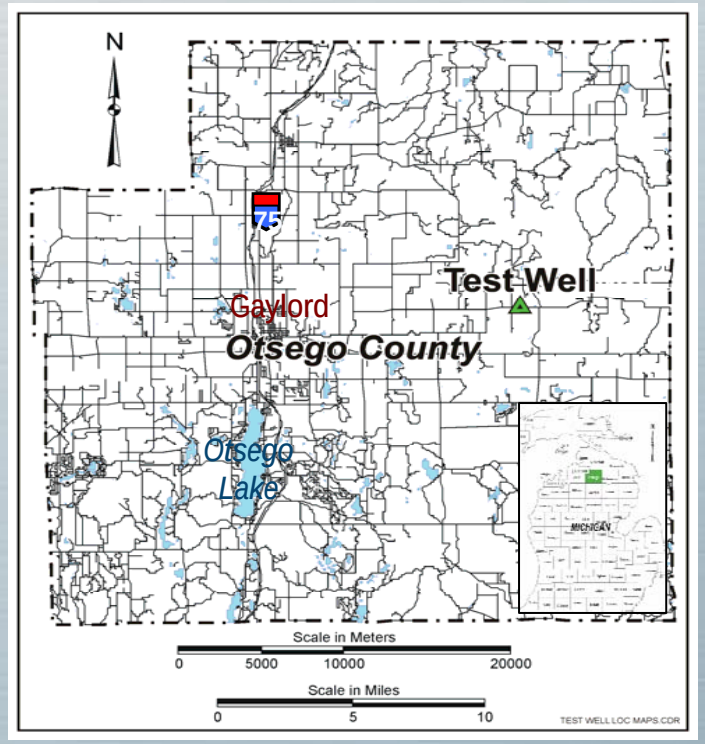
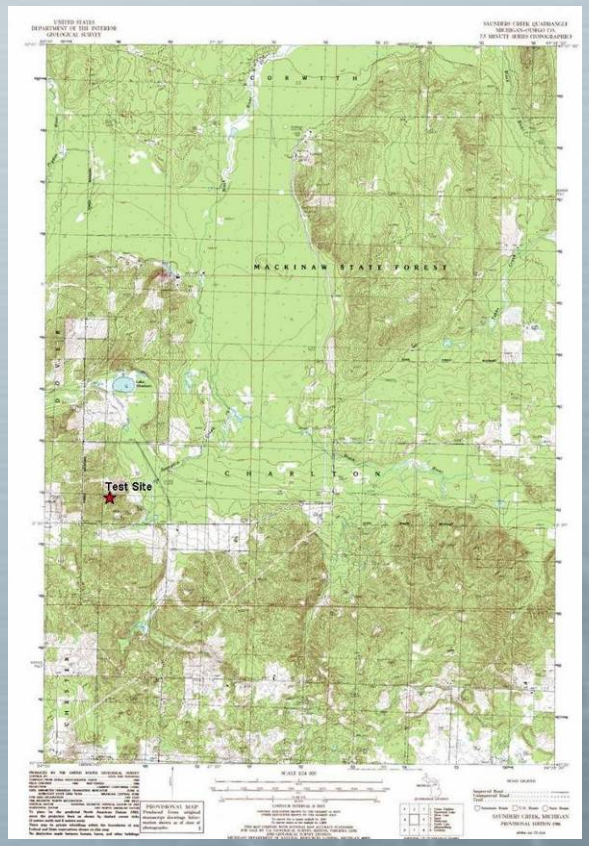


Site Description- Test Site

- The location is 16 km east of Gaylord, Otsego Co., Michigan.



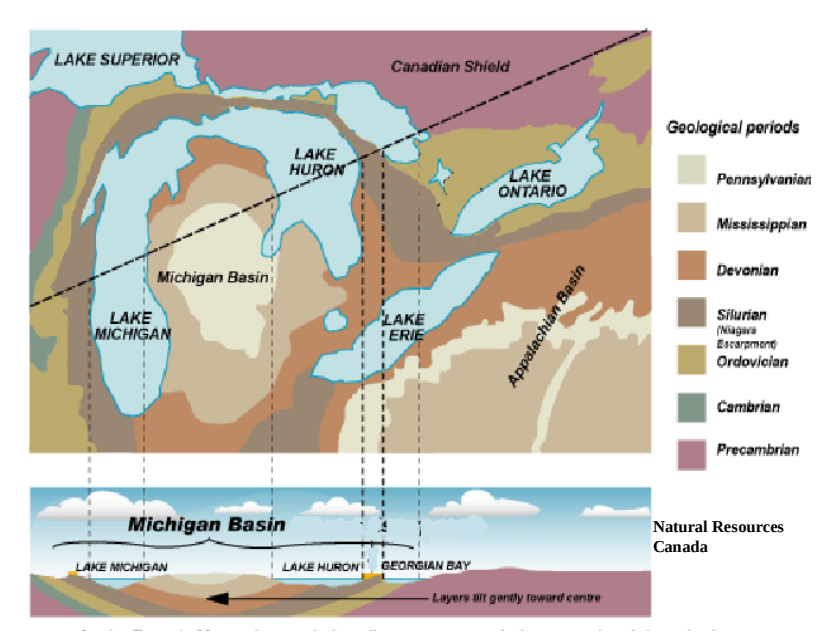


Site Description- Otsego County Test Site

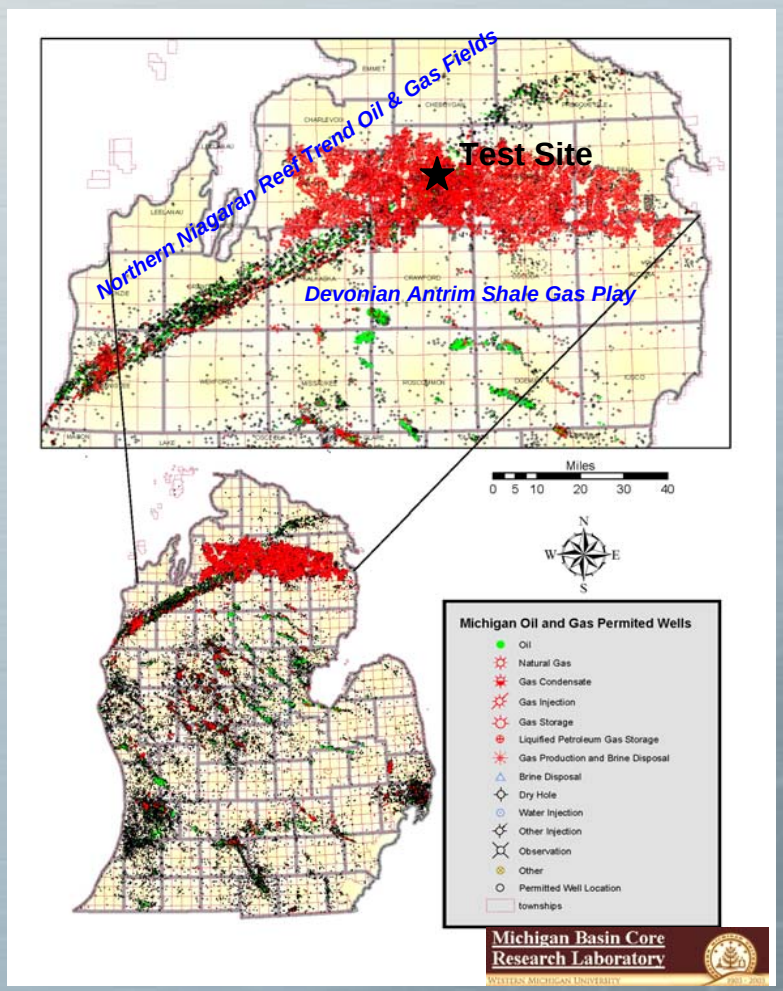
•Charlton 30/31 field, S. Dover/N. Chester Township, Otsego County, Michigan

Site Description- Geologic Setting

Michigan Basin

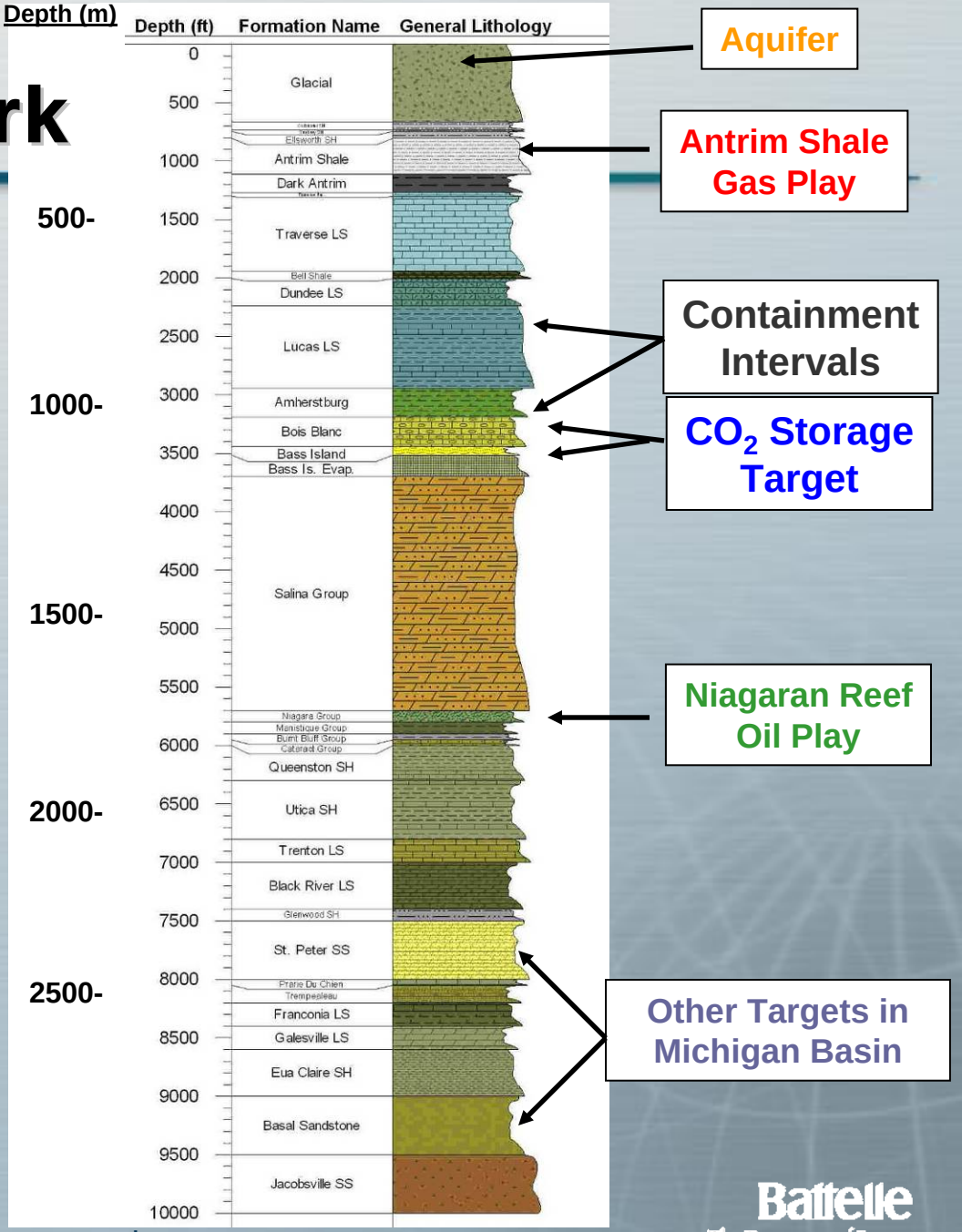


Oil and Gas



Site Description- Geologic Framework

- Mature sedimentary basin.
- Paleozoic sedimentary rocks ~2900 m deep and overlie Precambrian bedrock.
- Primary targets= Bass Islands Dolomite-Bois Blanc (972-1071 m).
- Containment layers: Amherstburg-Lucas formations (682-972 m).



Site Description- Geologic Framework

Containment- Amherstburg

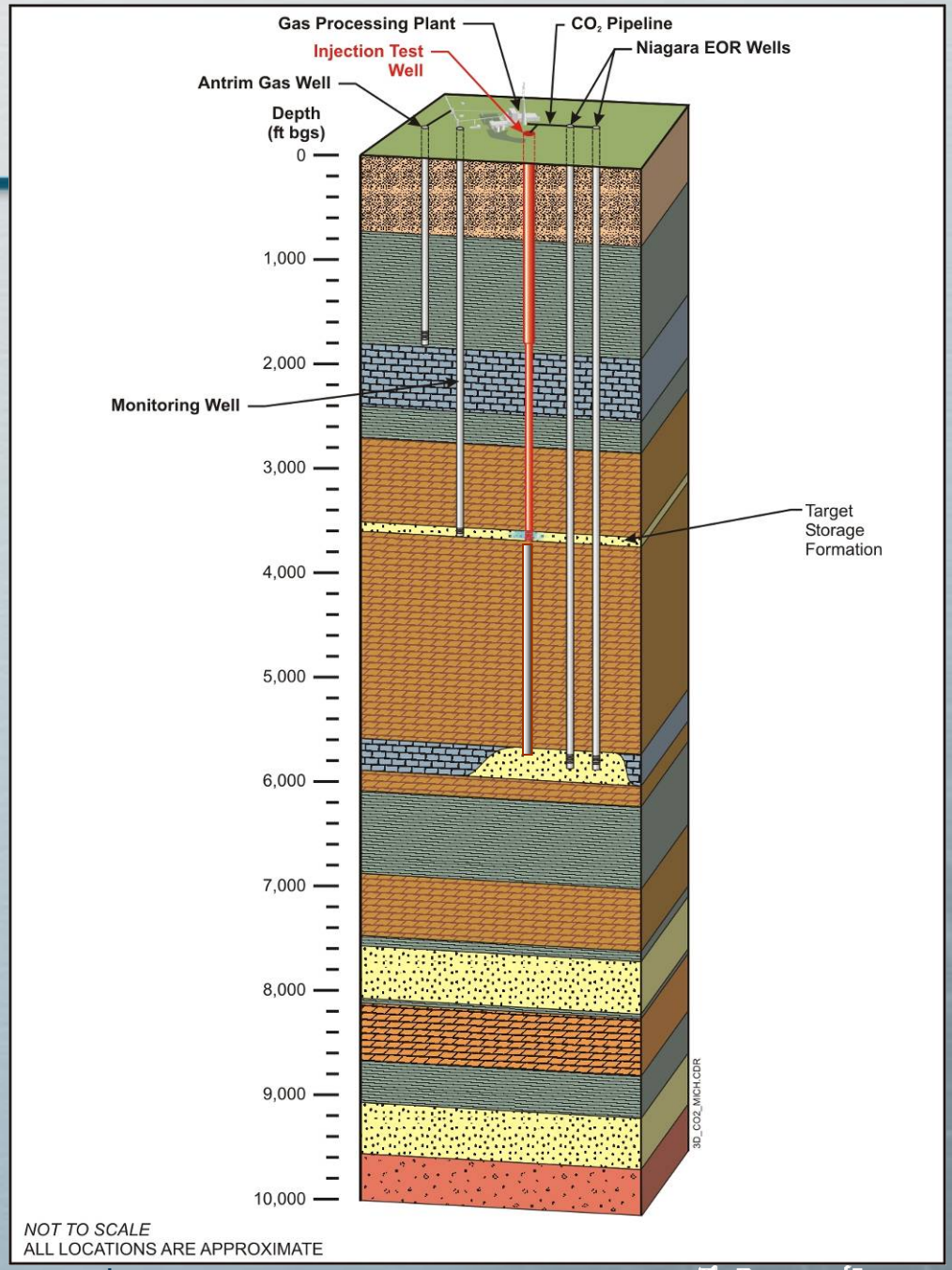
Target- Bass Islands Dolomite

Site Description- CO_2 Source

- CO_2 available from DTE Turtle Lake gas processing plant
- Antrim Shale gas contains 5-30% CO_2 and is removed in amine based separation process
- CO_2 dried and compressed at Core Energy Chester 10 facility
- CO_2 periodically piped as needed along ~13 km CO_2 pipeline for EOR floods in Niagaran Reef oil fields

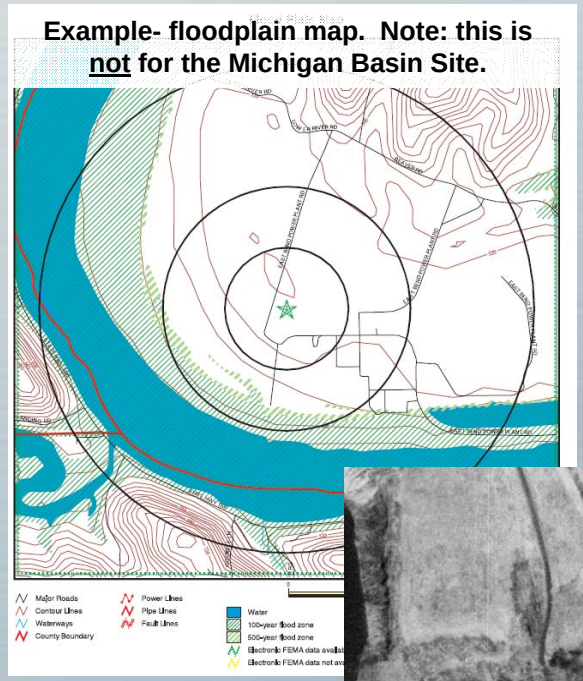
Site Description-System Diagram

- Bass Islands Dolomite-Bois Blanc deep saline formations primary target
- Amherstburg and Lucas formations and salt layers provide containment
- Drilled new injection well and retrofitted plugged well for monitoring
- Plan is to inject up to 10,000 metric tons over 60-90 days



Initial Screening

- Screen site for surficial features in project area-
  - Natural Areas
  - Historic Sites
  - Flood Plain
  - Wetlands
  - RCRA/CERCLA sites
  - Transmission lines
  - FAA/FCC sites
  - Surficial geology
  - Construction

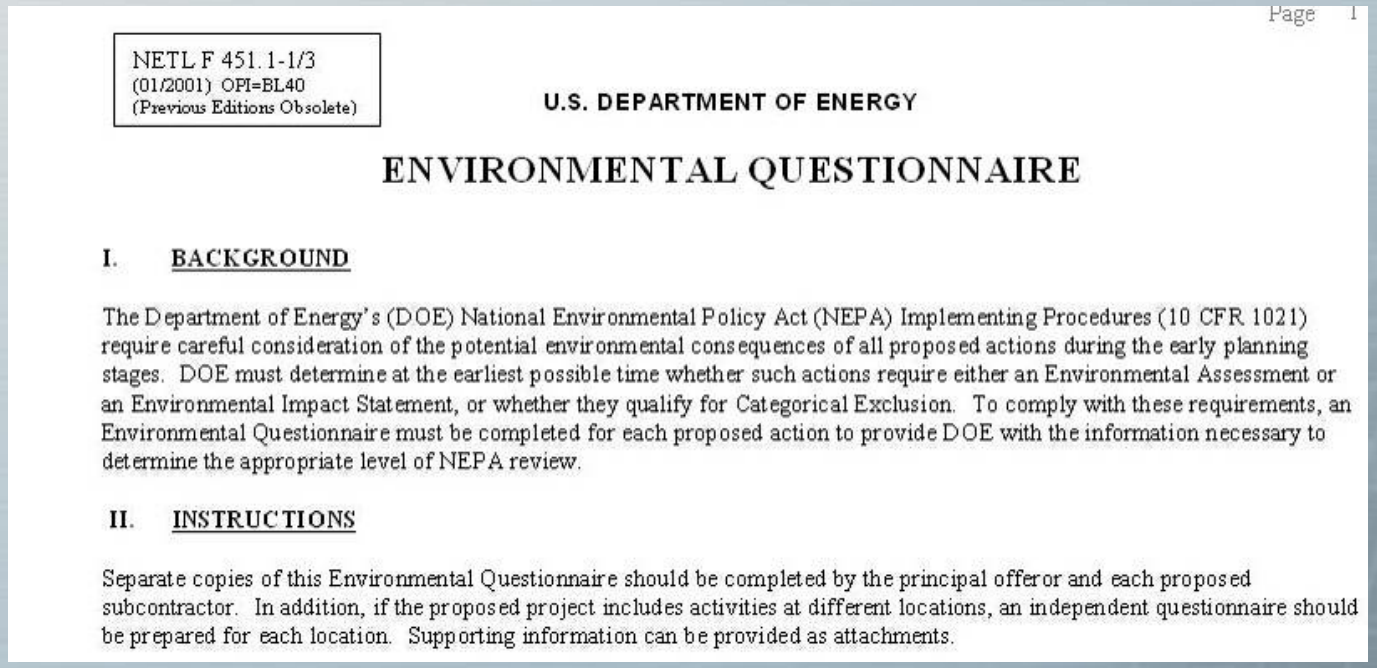


Example- floodplain map. Note: this is <u>not</u> for the Michigan Basin Site.

Example- historical aerial photo. Note: this is <u>not</u> for the Michigan Basin Site.

NEPA Environmental Questionnaire

- National Environmental Policy Act (NEPA) environmental questionnaire completed for test system prior to site work.
- Questionnaire submitted to DOE and the project received categorical exclusion.



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U.S. DEPARTMENT OF ENERGY

ENVIRONMENTAL QUESTIONNAIRE

I. BACKGROUND

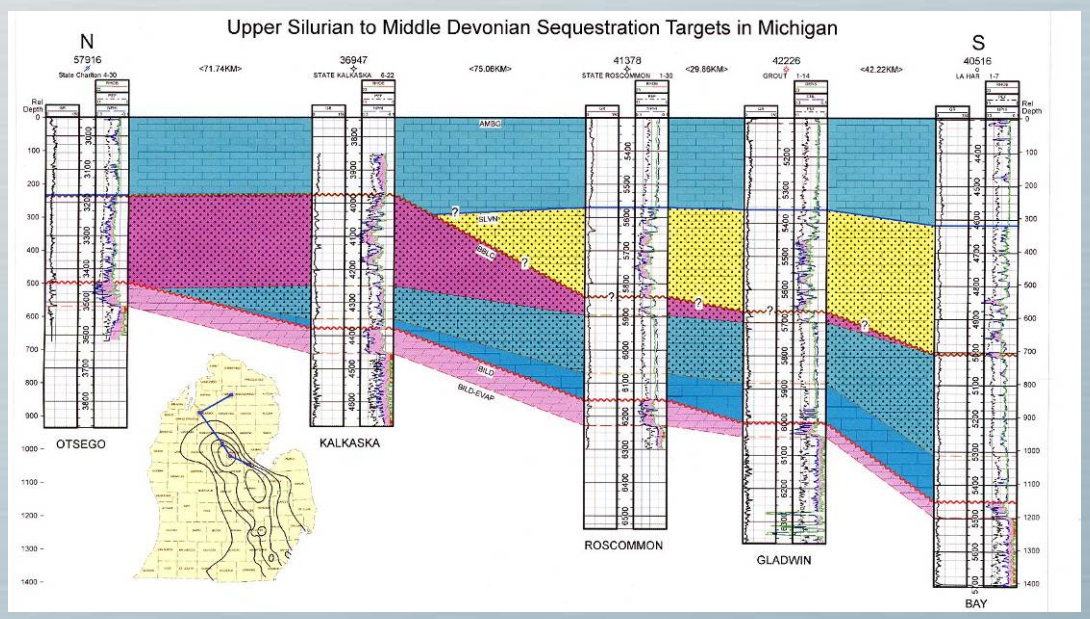
The Department of Energy's (DOE) National Environmental Policy Act (NEPA) Implementing Procedures (10 CFR 1021) require careful consideration of the potential environmental consequences of all proposed actions during the early planning stages. DOE must determine at the earliest possible time whether such actions require either an Environmental Assessment or an Environmental Impact Statement, or whether they qualify for Categorical Exclusion. To comply with these requirements, an Environmental Questionnaire must be completed for each proposed action to provide DOE with the information necessary to determine the appropriate level of NEPA review.

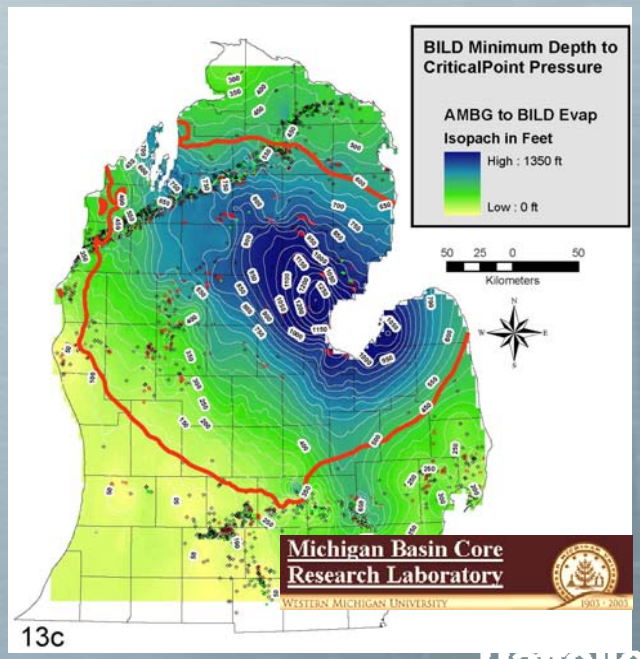
II. INSTRUCTIONS

Separate copies of this Environmental Questionnaire should be completed by the principal offeror and each proposed subcontractor. In addition, if the proposed project includes activities at different locations, an independent questionnaire should be prepared for each location. Supporting information can be provided as attachments.

Preliminary Geological Assessment

- Evaluate test site based on existing geological reports, maps, well logs, and other data.
- Performed by Michigan Basin Core Research Laboratory of Western Michigan University (Dave Barnes, Bill Harrison)
- Identify any regional geological features that may affect tests.





Well installation/completion

- Test well drilled on oil and gas well permit with Michigan State Department of Environmental Quality Geological and Land Management Division.
- Permit requires well site review of any features that may be affected by drilling (i.e. wetlands, public water supplies, buildings, etc.).

Well installation/completion

- Well Permit
  - Construction Specifications
  - Casing, cement plans
  - Drilling procedures
  - Blowout prevention

- State Environmental Impact Assessment:
  - Pit location/construction
  - Cuttings disposal plan
  - Brine disposal plan
  - Mitigation of Impacts from Drilling Plan
  - Soil erosion and Sedimentation Plan
  - Site restoration plan

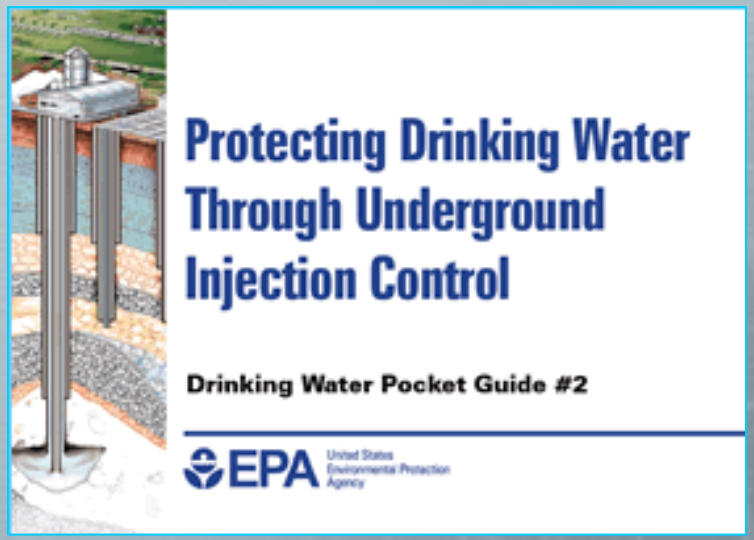
USEPA Underground Injection Control Permitting

- Geologic test sites are following *USEPA Underground Injection Control (UIC)* program: "*Using the Class V Experimental Technology Well Classification for Pilot Carbon Geologic Sequestration Projects- UIC Program Guidance (UICPG #83)*."

EPA UIC Program-

-Protect human health and the environment, drinking water

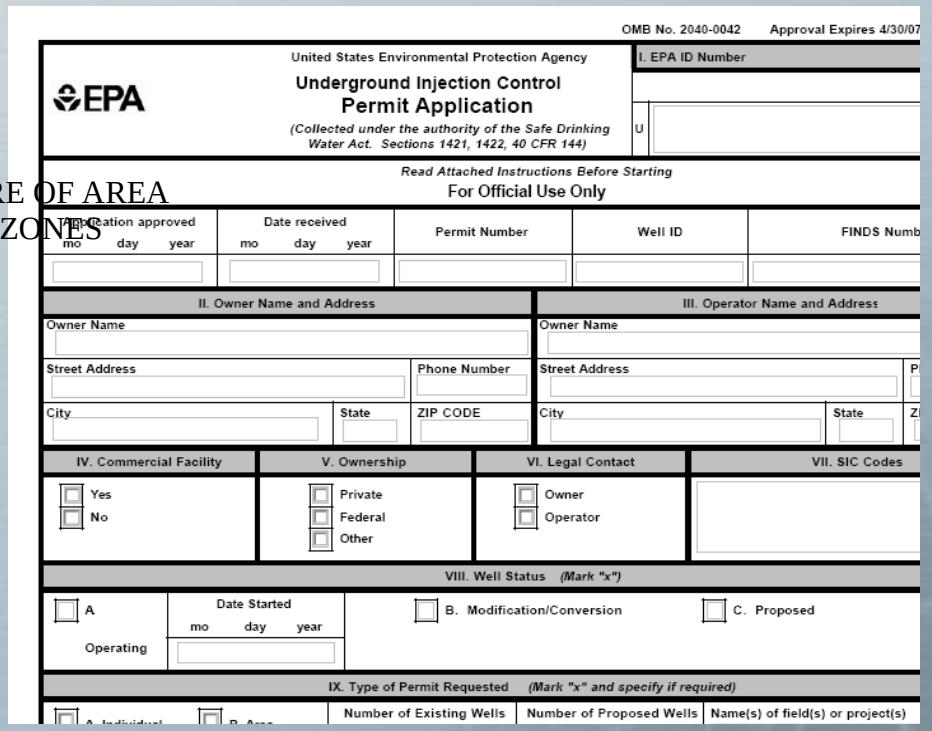
- Establish operating, monitoring, closure, review protocols



EPA Underground Injection Control Permitting

- Permit application submitted to Region V EPA
- Supporting Attachments Subset

A- AREA OF REVIEW METHODS
B- MAPS OF WELL/AREA OF REVIEW
C- CORRECTIVE ACTION PLAN AND WELL DATA
D- MAPS AND CROSS SECTIONS OF USDWS
E- NAME AND DEPTH OF USDWS
F- MAPS AND CROSS SECTIONS OF GEOLOGIC STUCTURE OF AREA
G- GEOLOGICAL DATA ON INJECTION AND CONFINING ZONES
H- OPERATING DATA
I- FORMATION TESTING PROGRAM
J- STIMULATION PROGRAM
K- INJECTION PROCEDURES
L- CONSTRUCTION PROCEDURES
M- CONSTRUCTION DETAILS
N- CHANGES IN INJECTED FLUID
O- PLANS FOR WELL FAILURES
P- MONITORING PROGRAM
Q- PLUGGING AND ABANDONMENT PLAN
R- NECESSARY RESOURCES
S- AQUIFER EXEMPTIONS
T- EXISTING EPA PERMITS
U- DESCRIPTION OF BUSINESS



OMB No. 2040-0042 Approval Expires 4/30/07

EPA

United States Environmental Protection Agency

Underground Injection Control Permit Application

(Collected under the authority of the Safe Drinking Water Act. Sections 1421, 1422, 40 CFR 144)

I. EPA ID Number

U

Read Attached Instructions Before Starting

For Official Use Only

Application approved mo day year	Date received mo day year	Permit Number	Well ID	FINDS Numb

II. Owner Name and Address			III. Operator Name and Address		
Owner Name			Owner Name		
Street Address	Phone Number		Street Address		P
City	State	ZIP CODE	City	State	Z

IV. Commercial Facility	V. Ownership	VI. Legal Contact	VII. SIC Codes
☐ Yes ☐ No	☐ Private ☐ Federal ☐ Other	☐ Owner ☐ Operator	

VIII. Well Status *(Mark "x")*

☐ A Operating	Date Started mo day year	☐ B. Modification/Conversion	☐ C. Proposed

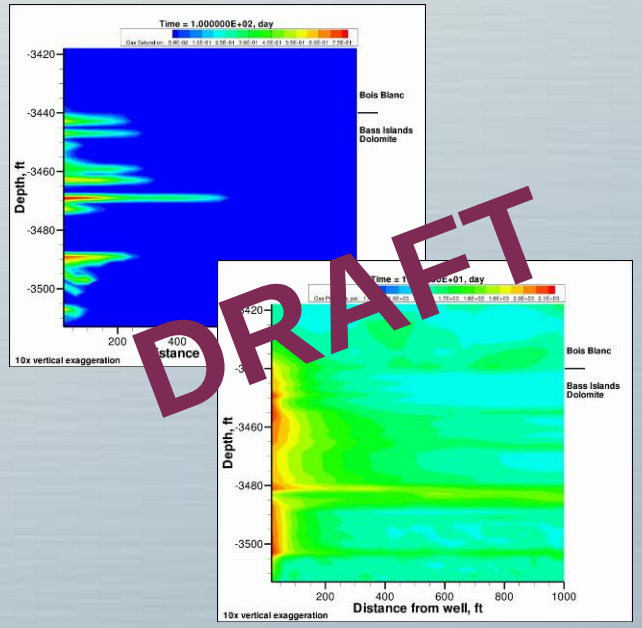
IX. Type of Permit Requested *(Mark "x" and specify if required)*

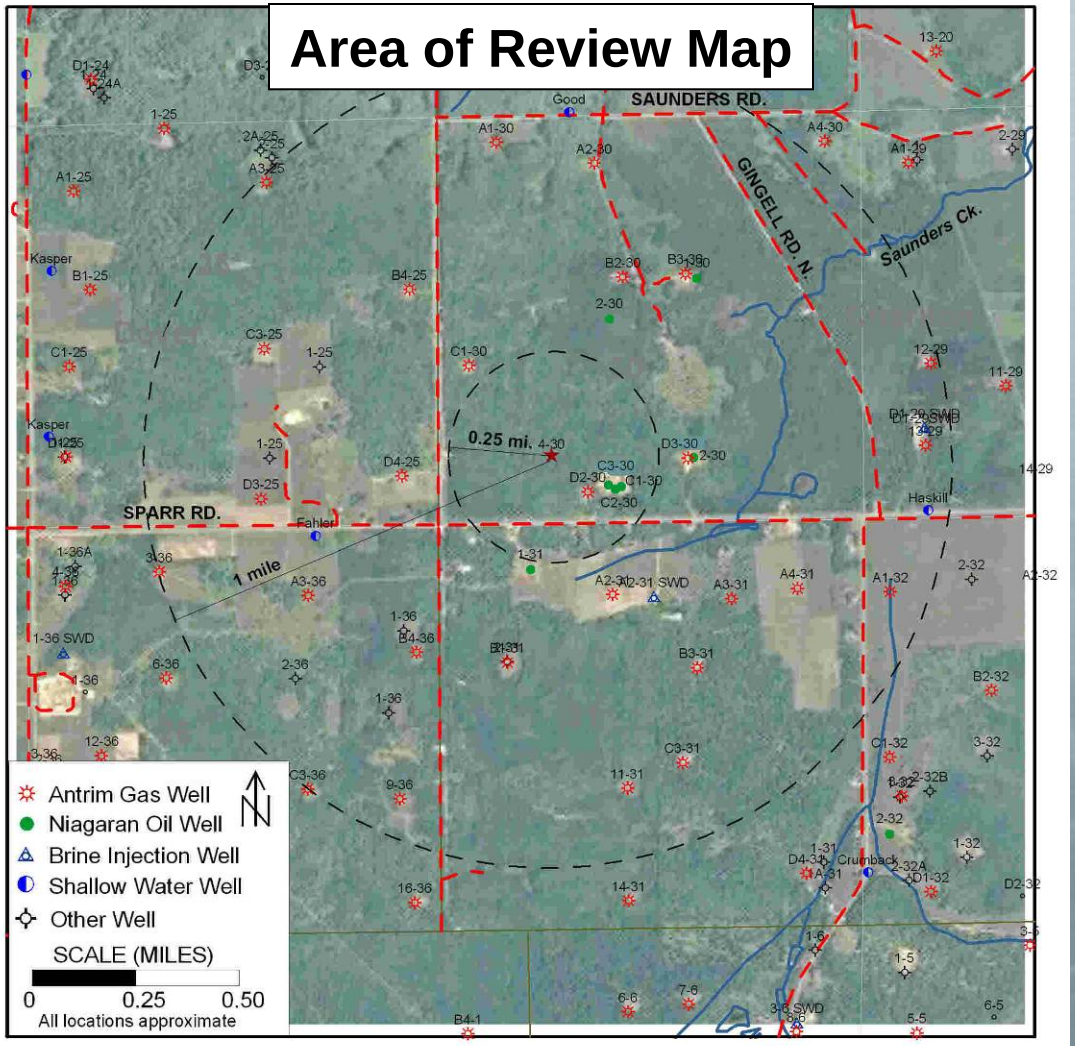
☐ A. Individual ☐ B. Area	Number of Existing Wells	Number of Proposed Wells	Name(s) of field(s) or project(s)

Example- Attachment B Maps of Well/ Area of Review

- AOR based on STOMPCO2 sims
- AOR to be validated with monitoring

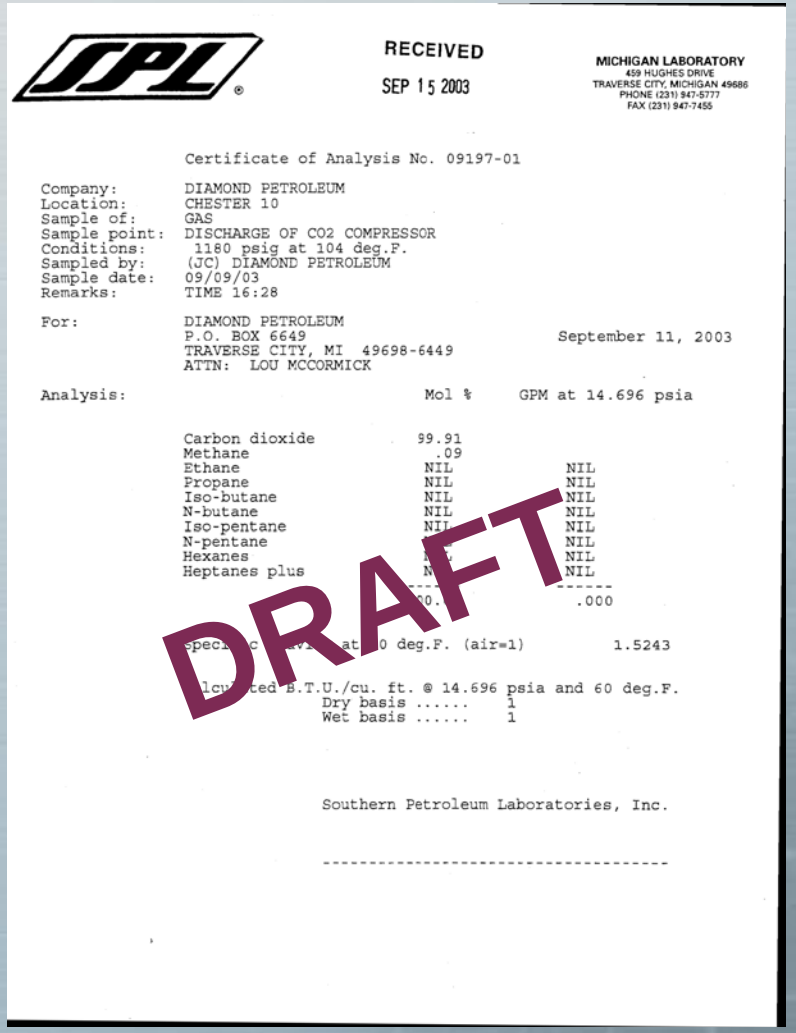
STOMPCO2 Simulations





Example- Attachment H Operating Data

- Injectate characterization
- Injection rate
- Injection pressures
- Injection pressure limit



SPL

RECEIVED
SEP 15 2003

MICHIGAN LABORATORY
459 HUGHES DRIVE
TRAVERSE CITY, MICHIGAN 49686
PHONE (231) 947-5777
FAX (231) 947-7455

Certificate of Analysis No. 09197-01

Company: DIAMOND PETROLEUM
Location: CHESTER 10
Sample of: GAS
Sample point: DISCHARGE OF CO2 COMPRESSOR
Conditions: 1180 psig at 104 deg.F.
Sampled by: (JC) DIAMOND PETROLEUM
Sample date: 09/09/03
Remarks: TIME 16:28

For: DIAMOND PETROLEUM
P.O. BOX 6649
TRAVERSE CITY, MI 49698-6449
ATTN: LOU MCCORMICK

September 11, 2003

Analysis:	Mol %	GPM at 14.696 psia
Carbon dioxide	99.91	
Methane	.09	
Ethane	NIL	NIL
Propane	NIL	NIL
Iso-butane	NIL	NIL
N-butane	NIL	NIL
Iso-pentane	NIL	NIL
N-pentane	NIL	NIL
Hexanes	NIL	NIL
Heptanes plus	NIL	NIL
	100.	.000

DRAFT

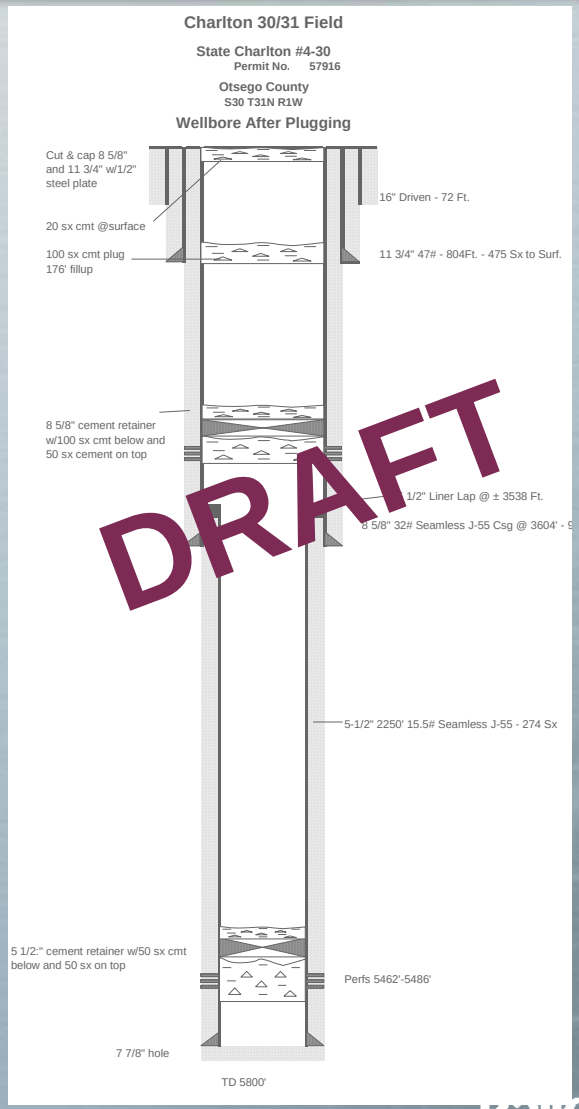
Specific [illegible] at 0 deg.F. (air=1) 1.5243

Calculated B.T.U./cu. ft. @ 14.696 psia and 60 deg.F.
Dry basis 1
Wet basis 1

Southern Petroleum Laboratories, Inc.

Example- Attachment Q Plugging and Abandonment Plan

- Plug well across perforated intervals.
- Cement across shallow aquifer.
- Plugging estimate and bond.

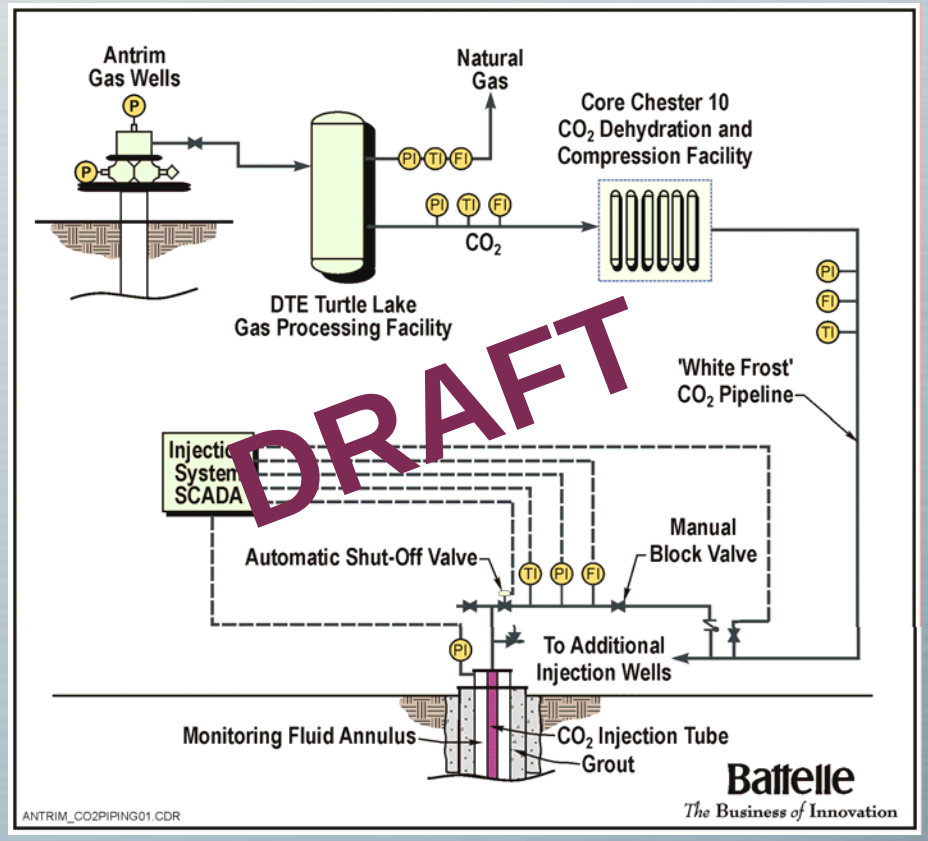


EPA Underground Injection Control Issues- (Based on USEPA Guidance)

- **Time scale/operational limitations-** while a limited test, the project should generate useful data to evaluate the possibility of larger projects.
- **Area of Review**- based on initial modeling, will be validated with modeling and monitoring.
- **Well construction**- utilize experience from EOR operations in the area.
- **Communication**- working with Region V EPA, field operator, State DEQ, DOE, and many others to implement test.

Injection Plans

- Injection of up to 10,000 metric tons CO_2 over 2-3 months.
- Injection rate may be adjusted to explore injectivity.



Monitoring

- Comprehensive monitoring program is planned to track injection test.
- Plan includes injection system monitoring.
- More research oriented monitoring aimed at studying the behavior of CO_2 in the subsurface.

Michigan Basin						
Time (Months)	-1	1	2	3	+1	2
Phase	Pre	Active Injection			Post	
Injection System (PVT)		X	X	X		
Health and Safety/Borehole		X	X	X	X	
Wireline (Nuetron/RST, PEX)	X		X		X	
X-Well Seismic	X				X	
Reservoir Brine Sampling	X		X		X	X
MicroSeismic/Slickwater	X	X	X	X (X)	X	
Well Indicator sensors (PT)	X	X	X	X	X	
4-D Seismic (with WMU program)					X	

Conclusions

- Comprehensive permitting approach helps facilitate CO_2 sequestration from site screening to closure.
- Many permitting procedures are established for drilling and underground injection.
- Much of the environmental permitting involves basic tasks that would be completed with any large construction project. They also help out with other aspects of the project.
- Monitoring program for MRCSP tests likely to exceed typical injection wells due to research objectives of the project.

The End

www.mrcsp.org